RECORD OF FOUR PREGNANT FEMALES OF THE SCALLOPED HAMMERHEAD, *SPHYRNA LEWINI* (SPHYRNIDAE) IN SENEGALESE WATERS.

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RÉSUMÉ. - Les auteurs rapportent la capture de quatre femelles gestantes de *Sphyrna lewini* (Sphyrnidae) dans la région marine de Dakar-Ouakam (Sénégal, Atlantique tropical oriental) et décrivent leurs contenus ovarien et utérin.

Key-words. - Sphyrnidae, *Sphyrna lewini*, ASE, Senegal, Pregnant females.

Three Sphyrnidae, *Sphyrna lewini*, *S. mokarran* and *S. zygaena* were identified in fish landings at the site of Ouakam, located 5 km from Dakar, in the Cape Verde Peninsula (Senegal, Eastern Tropical Atlantic). The first species is the most abundant hammerhead observed in this area (Capapé *et al.*, 1994). This is also the case in other areas of the world as Japan (Taniuchi, 1974), Taiwan (Chen *et al.*, 1988) and Australia (Last and Stevens, 1994). Compagno (1984) considered that *S. lewini* is the most abundant sphyrnid in the world. He added that the geographical distribution of the scalloped hammerhead is essentially circumtropical in coastal warm temperate and tropical seas.

Despite its relative abundance, the more detailed data on the reproductive biology of *S. lewini* are those given by Chen *et al.* (1988) from specimens caught in northeastern Taiwan waters. Other authors provided biological information on *S. lewini*, from Hawaii (Clarke, 1971), South Africa (Bass *et al.*, 1975), northwestern Gulf of Mexico (Branstetter, 1987, 1990), Gulf of California (Wakayabashi and Iwamoto, 1981; Klimley, 1987) and Australia (Stevens and Lyle, 1989; Last and Stevens, 1994). In eastern Tropical Atlantic areas, Cadenat and Blache (1981) observed numerous specimens of *S. lewini*; however they only recorded two pregnant females. These latter specimens were reported as *S. couardi*, but recently considered to be a junior synonym of *S. lewini* according to McEachran and Séret (1987).

In this paper, we report the capture of four pregnant females of the scalloped hammerhead from off the marine area of Dakar-Ouakam (Cape Verde Peninsula) which enable us to complete previous information recently published on this species (Capapé *et al.*, 1994).

Material and methods

Four pregnant females and 21 new-borns were captured by commercial gill-nets from October 1994 to August 1996. They were landed at the site of Ouakam where they were examined.

Sharks were measured to the nearest millimetre for total length (TL) following the methods of Compagno (1984) and Stevens and Mc Loughlin (1991). They were weighed on calibrated spring balances reading to the nearest 100 g for the specimens less than 20 kg, to the nearest 500 g for those over 50 kg. Measurements also included diameter (in mm) and weight to the nearest decigram for oocytes and eggs and to the nearest gram for the embryos or the foetuses.

Results

The first pregnant female examined was captured in May 1995. It was 2510 mm TL, and its weight 52 kg. Only the right ovary was functional, it weighed 124 g and it contained two crops of oocytes (Fig. 1A). In one crop, 22 oocytes were counted, among them 12 were measured. Their diameter ranged from 19 to 22 mm (mean: 20.20; sem: 1.11), their weight from 3.8 to 4.5 g (mean: 4.13; sem: 0.22). The second crop included 15 oocytes. Their diameter ranged from 14 to 16 mm (mean: 15.3; sem: 0.81); their weight from 1.80 to 2.44 (mean: 2.11; sem: 0.25). The right uterus was not compartmentalised and was empty. In contrast, the left uterus was divided into five chambers. The first chamber contained 9 ova, each enveloped in a single capsule. The capsule was ochraceous and diaphanous, with a short expansion at each end. Unfortunately, these eggs were partially damaged, and we were unable to measure them. Ova weight range was 4-5 g. A second uterine chamber had one encapsulated ovum with one of the two ending filaments more expanded than the other. This egg was strongly ellipsoidal, its greater diameter was 70 mm, its smaller 30 mm; it weighed 31 g (Fig. 1B). The third chamber had a single egg measuring 65x35 mm and weighing 31 g. In the fourth chamber, there was one female embryo of 320 mm TL, weighing

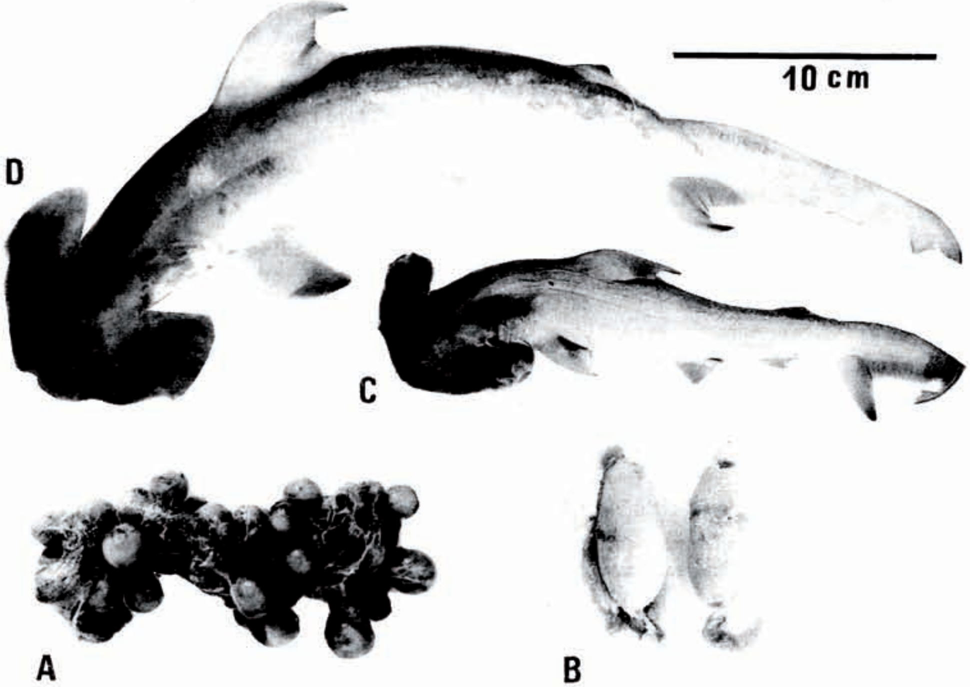

Fig. 1. - Oocytes of the right ovary (**A**), eggs (**B**), embryo of 320 mm TL (**C**) and near term foetuses of 480 mm TL (**D**) found in the left uterus of the 2510 mm TL female caught off Dakar-Ouakam.

99 g (Fig. 1C) and with an umbilical stalk of 150 mm TL. The fifth chamber contained a larger female embryo, 480 mm TL, and 467 g in weight (Fig. 1D) and with an umbilical stalk 370 mm in length.

The second pregnant female was caught at the beginning of July 1995. It was 2630 mm TL and weighed 62 kg. The third and the fourth female were both caught at the end of May 1996. They were 2560 mm and 2580 mm TL respectively. They both weighed 50 kg. Their ovary content and their uteri content were reported in table IA and in table IB respectively. The same number of foetuses were counted in each uterus. Among the foetuses, the females were always more numerous than males.

Discussion

The data reported in this paper reveal analogies with the observations made by Chen *et al.* (1990) in pregnant females *S. lewini* captured in the northeastern Taiwan waters.

According to these authors, the ripe oocytes ready to be ovulated were more than 25 mm in diameter. The diameter of the oocytes we have observed ranged from 21 mm to 25 mm. Nevertheless, their weight was practically the same as that of the eggs found in the uterus of the first female, thus these oocytes were probably closed to ovulation.

Branstetter (1987 and 1990) reviewing previous reports of full-term embryos and free swimming young wrote that in *S. lewini*, the young were between 400 and 500 mm TL. The same author (1987) estimated the size at birth by the von Bertalanffy curve as 490 mm TL. The TL of the observed foetuses (Table IB) ranged from 370 to 520 mm. They probably were at the time of parturition. This hypothesis could be supported by observations concerning TL of smallest free living specimens made in the area of Dakar-Ouakam, from 1994 to 1996. This size ranged from 460 mm to 525 mm in 10 males and from 435 mm to 502 mm in 11 females. All these specimens exhibited an umbilical scar and bore a residual internal yolk sac.

The simultaneous presence of ripe oocytes and fully developed foetuses in the uteri of the same female suggests that vitellogenesis proceeds in parallel with gestation in *S. lewini* as in other carcharhinids and sphyrnids (Dodd, 1983; Mellinger, 1989).

Bass *et al.* (1975) also observed undeveloped eggs in the uterus of one pregnant female caught at Durban (South Africa), but did not comment this phenomenon. The aggregation of smaller ova into a single, larger ovum enveloped in a single capsule seems to be rather unusual. This aggregation probably occurred during ovulation. However, the fact that each larger single ovum was found in a separate uterine compartment seems to indicate that compartmentalisation occurred some time after the aggregation of the smaller ova.

Compagno (1984) noted that the number of young per litter ranges from 15 to 31 and Branstetter (1990) stated that the species produces more than 30 young per litter. Chen *et al.* (1988) reported that counts of uterine embryos as well as eggs of 110 gravid females ranged between 12 and 38 (mean 25.8). Cadenat and Blache (1981) wrote that the two pregnant females observed in Senegalese waters were 2300 mm and 2350 mm TL respectively. The former bore 24 foetuses and the latter 28. Chen *et al.* (1988) showed a relationship between fecundity and total length of *Sphyrna lewini* females. According to results plotted in table I, the ovarian fecundity (number of oocytes) is higher than uterine fecundity (number of foetuses). The females observed give 18-22 young per litter, this agree with previous data reported from other areas. Chen *et al.* (1988) added that sex-ratio differed by litter, but as the whole it was 1:1. In the first female, we have observed two females, and in the three other the sex-ratio was predominantly female.

The two pregnant females observed by Cadenat and Blache (1981) were both caught off

Table I. - Features of four pregnant females of *S. lewini* caught from off the marine area of Dakar-Ouakam. **A**: Right ovary content; **B**: Uteri content. (n): number of oocytes measured and weighed.

Date of capture		**July 1995**	**May 1996**	**May 1996**	**May 1995**
Size (Tl, mm)		2630	2550	2580	2510
Weight (kg)		62	50	50	52
A.		**Right ovary content**			
Number of oocytes (n)		46 (40)	40 (20)	40 (18)	37 (22)
Oocyte diameter (mm)	**range**	21 - 24	21 - 25	22 - 25	19 - 22
	mean	22.35	22.85	23.00	20.20
	sem	1.01	0.98	1.08	1.11
Oocyte weight (g)	**range**	4.1 - 4.6	4.0 - 4.4	4.1 - 4.5	3.8 - 4.5
	mean	4.35	4.20	4.22	4.13
	sem	0.16	0.14	0.13	0.22
B.		**Uterus content**			
Number of fetuses	**males**	9	6	6	0
	females	13	10	12	2
Fetuse size (TL, mm)	**range**	360 - 520	390 - 460	430 - 465	320 - 480
	mean	458.18	448.20	439.12	-
	sem	48.36	11.88	22.28	-
Fetuse weight (g)	**range**	347 - 630	430 - 650	490 - 630	99 - 467
	mean	452.18	588.81	541.11	-
	sem	69.79	53.91	134.72	-

southern coast of Senegal. The first female was captured in December, but the authors did not report the size of uterine content, the second in March. It bore foetuses which were between 300 and 310 mm TL. Their size showed that they were developing foetuses. The foetuses we have observed were fully developed, at the time of parturition. In *S. lewini* from the coast of Senegal, parturition probably occurs from May to July.

In the area of Dakar-Ouakam, pregnant females ready to give birth and new-borns of *S. lewini* are concomitantly captured during the same period of the year. Capapé *et al.* (1994) reported similar observations in other Elasmobranch species. According to the definition of Castro (1993), this area could probably be an Elasmobranch nursery.

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